RELATION BETWEEN TRUNK IMPAIRMENT AND UPPER LIMB KINEMATICS OF REACHING NEAR AND FAR OBJECT UNDER ALTERED SENSATION IN POST STROKE PATIENTS A CROSS SECTIONAL STUDY

Dissertation submitted in

the Partial fulfilment

for the degree of

MASTER OF PHYSIOTHERAPY

(Neurology)

The Tamil Nadu DR. M.G.R. Medical University

Chennai

May 2018

PSG COLLEGE OF PHYSIOTHERAPY

Coimbatore

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CERTIFICATE

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ABBREVIATIONS

RPS	-	Reaching Performance Scale
TIS	-	Trunk Impairment Scale
TD	-	Trunk Displacement
MMSE	-	Mini Mental Status Examination
MCA	-	Middle Cerebral Artery
ADL	-	Activities of Daily Living

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LIST OF ANNEXURES

CHAPTER - I

INTRODUCTION

Stroke is a global health problem. It is the second commonest cause of death and fourth leading cause of disability worldwide (Strong 2007). Stroke is a leading cause of functional impairments;About 85% of the patients experience some degree ofparesis of the upper limb and more over 50% of them shows impaired upper limb and hand function in the chronic phase.with 20% of survivors requiring institutional care after 3 months and 15%-30% being permanently disabled (Steinwarks 2000). In Indian population stroke is relatively common in young population [Indian population 60years ≥ 7.5% compared to the west (e.g. British population ≥ 65 years)]. In India the annual incidence of stroke is about 145 per 100,000 per year during 2003-05 and 2005-06.

The greatest impact of stroke on both patients and families are the long-term disability, including impairments, limitations of activities and participation restrictions in life situations. As one of the most cause of disability, stroke imposes an economic burden in several countries. After stroke, patients usually present sensorimotor impairments contralateral to cerebral lesion, in that upper limb impairments are very common and challenging problem after a stroke. Those impairments involve difficulty in moving and coordinating the arm, hands and fingers that contribute to limiting their ability to perform functional activities such as eating, dressing and washing, which is considered a fundamental prerequisite for daily activities and is commonly compromised.

Improving the arm function is a core element of occupational performance for quality of life. For that trunk stability and the control is considered to be a pre-requisite to upper extremity function. Recent studies show, stroke affects the control of trunk muscles and therefore ability to remain upright, adjust to weight shifts and perform selective trunk movement to maintain the stability during static and dynamic postural adjustments[3]. Since the trunk is thought to play an integral role in postural stabilization by supporting controlled movement of upper extremity during task performance, it is necessary to correlate the relationship between the trunk and upper extremity.

Proximal stability of the trunk is a prerequisite for distal head and limb movement and therefore expected to berelated to functional ADL.Trunk performance is an important predictor of functional recovery after stroke.[5]Although a greater extent of bilateral hemispheric input innervates the axial trunk muscles than lateral limb muscles, upper motor neuronlesions still cause detectable functional changes in trunk control.[6]

Stroke subjects have difficulties in generating and maintaining the velocity of trunk's Centre of mass during the reaching task, which may be associated with impairments of trunk muscles. Recent movement analysis studies have shown that patients with hemiparesis use excessive trunk and shoulder girdle displacement when pointing to targets or attempting to reach and grasp object placed within and beyond the reach of arm**[15]**. However studies investigating relationship between trunk impairment and kinematics of upper extremity in stroke subjects were not found.

Currently, there is no research which builds upon these findings to investigatethe impact of trunk control on recovery of upper extremity function in strokepatients specifically, even though the upper extremity plays a vital role in theperformance of ADL (Houwinket al.2013). It is reported that 80% of acute stroke patients and 40% of chronicstroke patients show a reduced ability to use the paretic upper extremity inADL (Langhorne et al. 2011).The relationship between reaching and ADL independence is reflected inmeasures such as the Barthel Index and FIM, where the ability to reach isrequired for over 50% of the activity of daily living tasks (Ingram et al. 2008). Following stroke, difficulty with reaching may leadto further dependence and possible long-term disability (Chen et al. 2013b). Armmotor function has been shown to correlate strongly ($r = 0.76$, $p < 0.05$) withthe Barthel Index (Sveen et al. 1999). Furthermore, movements of the affectedupper extremity in stroke patients explain up to 40% of the variance in abilitiesto perform the normal ADL (Mercier et al. 2001). Strong evidence exists tosupport upper extremity paresis as one of the key predictors for outcome ofADL (Veerbeek et al. 2011).Given that evidence from the above-mentioned studies supports trunkperformance as a predictor of ADL and the existence of a close relationshipbetween upper extremity function and ADL, It is probable that there is anassociation between trunk control and upper extremity in ADL performance.Hence, research investigating the relationship between trunk control andrecovery of upper extremity function in stroke patients is warranted.

Trunk control, which is the foundation of posture, is a critical element for early reaching (Rachwani et al. 2013). The ability to control the head, trunk and arm, both separately and with respect to each other is a skill that improves with age, even though the youngest infants were able to perform the reaching task in an elementary way (Sveistrup et al. 2008). Ability tocontrol the trunk influences the quality of reaching (Hopkins &Ro□nnqvist 2002).Drawing the findings from developmental science, it is evident that trunkcontrol has an impact on the quality of reaching. Inferring from this,

Trunkcontrol is essential for appropriate dissociation of the upper extremity fromthe trunk for function. As the reaching task will cause postural perturbation asthe upper extremity moves, appropriate postural adjustments are essential tocounteract such perturbation. By having a stable base or platform, in the formof good trunk control, it will facilitate various musculatures of the distal andproximal segments of the upper extremity to work against a background oftrunk stability, hence enabling the ability of the upper extremity for function.In conclusion, the perspective offered by developmental science aid inunderstanding of the relationship between trunk control and upper extremity.This leads on to the next section on research related to pointing and reachingin adult stroke patients[9].

Numerous studies have demonstrated that stroke patients exhibit excessivetrunk and shoulder girdle movements during pointing tasks, reach-to-graspmovement or when performing upper extremity elevation (Shaikh etal. 2014). In addition, studies have also confirmed the presence ofdeficits in interjoint coordination during pointing and reaching tasks followingstroke[8]. Movements ofthe affected upper extremity in individuals with stroke are segmented, slower,and characterized by a greater variability and by deflection of the trajectoryfrom a straight line (Dipietro et al. 2009). Abnormal muscleco-activation and abnormal joint torque production in the paretic shoulder andelbow also account for the difficulty faced by stroke patients during pointingand reaching to targets (Dewald& Beer 2001; Liu et al).

The measurement of the performance of the affected arm and hand of patients with hemiparesis is important for determining the goals of intervention as well as the outcomes of rehabilitation. Within the task-oriented model, there are 3 levels of performance of interest to clinicians. One level is functional ability and is related to activity according to the ICFDH classification. The other 2 levels are related to impairment and concern movement strategies used to accomplish a task and sensorimotor impairments.

Reaching performance scale was to identify and quantify the degree of motor compensations used by patients when reaching to grasp an object placed within the reach of the arm (task 1) and beyond the reach of the arm (task 2). The 2 different tasks were used because movement analysis studies have shown that the transport requirements of the arm when grasping objects located close to and far from the body are different. RPS scale evaluates 6 components. Four components are related to reaching close and far targets: trunk displacement, movement smoothness, shoulder movements, and elbow movements. The 2 additional components globally rate the quality of prehension, Only the reach-to-grasp component of the task and not the transport of the cone after grasping was assessed because the scale was designed to be an impairment scale assessing the impairment of reaching and not the functional disability associated with object manipulation. In general, ICCs revealed good or excellent preliminary reliability of the total RPS score, according to the criteria proposed for ICCs by Sneeuw et al, based on the interpretation scale of Landis and Kock,an ICC of .81 to 1.00 is excellent, an ICC of .61 to .80 is good, an ICC of .41 to .60 is moderate, and an ICC of .40 or less is poor. Based on this interpretation, some of our lower confidence interval limits that were inferior to .61 may be considered as reflecting moderate reliability[1].

Trunk Impairment Scale (TIS) for patients after stroke was designed to measure ADL related selective trunk movements.The TIS assesses static and dynamic sitting balance and trunk coordination. TIS attempts to assess trunk function at the impairment level (i.e., PTV, postural reflexes [righting reflexes],The TIS has sufficient reliability, internal consistency and validity for use in clinical practice and stroke research. Intra-observer and inter-observer reliability is high. Test/retest and interobserver reliability for the TIS total score (ICC) - 0.96 and 0.99, respectively. The 95% limits of agreement for the test/retest and interexaminer measurement error - 2/2.90, 3.68 and 2/1.84, 1.84, respectively. Cronbach alpha coefficients for internal consistency range from 0.65 to 0.89[3].

In order to be able to adapt to a challenging environment, stroke survivors may be required to learn highly complex skills like performing reaching task under altered conditions (stable and unstable surface). Moreover in literatures trunk control and upper limb functions were tested in stable conditions but in day today life patient has to experience many unstable conditions

Hence the evaluation of relation between trunk impairment and upper limb kinematics during reaching on stable and unstable condition is essential. Exploration of these associations is important for guiding the development of intervention for stroke survivors.

Considering the impairments of trunk and limitations in reaching under altered conditions in stroke subjects, it is possible that these limitations are related to one other. Hence this study aimed a) To find the difference in trunk control on stable and unstable condition b) To find the difference in upper limb kinematics in reaching on stable and unstable condition c) To find the relation between trunk impairment and upper limb kinematics during reaching on stable and unstable condition.

1.1 NEED FOR THE STUDY:

The development of trunk stability and control is considered to be a prerequisite to upper extremity (UE) function and use of the hand. It has been shown that proximal stability allows for independent use of the arms and hands in manipulative and purposeful activity. These studies have concluded that improvement in trunk control is related to significant changes in upper limb functions. Studies of motor recovery following stroke have shown that improvements in outcome measures such as speed, precision, and variability of arm movement may be accomplished by stroke patients in ways that may be maladaptive or compensatory, Achieving the function using compensatory pattern will result in learning abnormal pattern and atypical movement which is not recommended for patient with potential for recovery. It is important to analyze the kinematics of the upper limb during functional task so that the abnormal pattern can be identified and normal pattern can be rehabilitated. Moreover in literatures trunk control and upper limb functions were tested in stable conditions but in day today life patient has to experience many unstable conditions. Therefore it is important to find the relation between trunk impairment and kinematics of upper limb in unstable condition.

1.2 OBJECTIVE

* To find the difference in trunk control on stable and unstable condition
* To find the difference in upper limb kinematics in reaching on stable and unstable condition
* To find the relation between trunk impairment and upper limb kinematics during reaching on stable and unstable condition.

1.3 HYPOTHESIS

* **NULL HYPOTHESIS:** there is no difference in trunk impairment and upper limb kinematics of reaching on stable and unstable condition. There is no relation between trunk impairment and upper limb kinematics of reaching on stable and unstable condition.
* **ALTERNATE HYPOTHESIS:** there is a difference in trunk impairment and upper limb kinematics of reaching on stable and unstable condition. There is a relation between trunk impairment and upper limb kinematics of reaching on stable and unstable condition.

1.4 OPERATIONAL DEFINITION

REACHING PERFORMANCE SCALE:

The Reaching Performance Scale (RPS)—for the identification and quantification of movement patterns and their compensations during reach-to-grasp tasks in patients with upper-extremity hemi paresis secondary to a stroke. This scale particularly focuses on compensatory movements used during the *transport phase of reaching*, and also includes a measure of compensatory strategies used for grasping.

TRUNK IMPAIRMENT SCALE:

The trunk impairment scale is used to measure the motor impairment of the trunk after a stroke through the evaluation of static and dynamic sitting balance as well as co-ordination of trunk movement.

CHAPTER – II

REVIEW OF LITERATURE

* **Verheyden, et al., (2015)** conducted a study to determine the discriminant ability of the TIS by comparing stroke patients with healthy individuals. The study involved forty stroke patients and 40 age- and sex-matched healthy individuals. Sub-scale and total TIS scores showed significant differences between stroke patients and healthy individuals ($P < 0.0001$). Univariate analysis and logistic regression analysis further revealed that younger persons, women and people who are more active in daily life have a higher chance of obtaining a high score on the TIS.

* **Pereira, et al., (2014); Shaikh et al., (2014)** Their studies have demonstrated that stroke patients exhibit excessive trunk and shoulder girdle movements during pointing tasks, reach-to-grasp movement or when performing upper extremity elevation. And concluded that Excessive trunk displacement (TD) may occur in forward flexion and lateral flexion.

* A study by **Massie and Malcolm, (2012)** on 11 chronic stroke patients demonstrated that emphasizing patients to increase their reaching speed between two targets led to improved kinematic of the trunk and upper extremity. Patients reached significantly faster and smoother during the task while maintaining target accuracy. A notable finding is that patients used significantly less anterior trunk displacement during the fast condition, and yet not exhibiting any significant change in shoulder flexion. Hence, this implies that increasing the speed of reaching may be a more optimal motor control strategy without compromising the accuracy of reaching. This serves as a valuable point for therapists to consider as they can vary the speed of task execution to challenge the patients and yet achieve a desirable minimal compensatory trunk movements during training.

* **Van Kordelaar, et al., (2012) Thielman (2013)** Numerous studies have demonstrated that stroke patients exhibit compensatory trunk movements during pointing and reaching. The compensatory trunk movements may occur in forward flexion and lateral flexion.

* **Gialanella, et al., (2012)** The relationship between trunk performance and functional outcome are further supported by a recent study on 30 chronic stroke patients demonstrated a highly significant correlation (r = 0.911) between trunk control (TIS-V) and Tinetti balance subscale (Jijimol et al. 2013). In a cross-sectional study on 51 subacute and chronic stroke patients, Verheyden et al. (2006) showed significant relationships between trunk performance (TCT and TIS-V) and measures of balance (Tinetti balance subscale), and functional ability (FIM) after stroke. It was also worthy to note from the study that trunk performance was still impaired to some extent in the chronic stroke patients as none of them attain maximum score on the Trunk Impairment Scale. This finding of residual trunk impairment post stroke is consistent with those in other studies, The trunk impairment in chronic stroke patients may affect their optimal functioning in ADL.

* Recently, **Van Kordelaar, et al., (2012)** provided further insights into the relationship between the trunk and upper extremity post stroke. The researchers investigated the interaction between pathological limb synergies and compensatory trunk movements during reach-to-grasp with the paretic upper extremity. Principal component analysis was used to identify components representing linear relations between the degrees of freedom of the upper extremity and trunk across stroke patients. In addition, FMA was found to be significantly related to components 2 ($p = 0.014$) and 3 ($p = 0.003$) in stroke patients. This confirms the use of compensatory trunk movements is related to the presence of basic limb synergies as quantified by the FMA.

* In a recent study, **Robertson and Roby-Brami, (2011)** observed significantly larger degree of trunk flexion ($p < 0.01$) and rotation ($p < 0.05$) in their sample of 16 stroke patients (11 subacute stroke and 5 chronic stroke patients) during reaching tasks in a

large three-dimensional workspace adjusted to each individual patient's arm length. The researchers also questioned whether the significantly larger trunk flexion and rotation observed was a result of impaired trunk control or as a result of compensatory strategies of using the trunk to assist in reaching. Robertson and Roby-Brami (2011) recommended future research to investigate this aspect. Hence, this recommendation also supports the justification for this study to investigate the impact of trunk control on upper extremity function in stroke patients.

* **Cuesta-Vargas, et al., (2010)** conducted movement analysis on Kinematic measures of movement can be captured by a motion capture system and wearable inertial sensors. Such data are useful objective measurements for research and for guiding clinical practice. The kinematic measures help to quantify normal and pathological movements, quantify the degree of impairment, plan rehabilitation strategies and assess the effects of therapeutic interventions

* **Subramanian, et al., (2010)** conducted a retrospective study of kinematic data from research related to pointing and reaching in stroke patients revealed vital information about the contribution of the trunk .in the reach-to-grasp task, TD alone explained 52% of the variance in FMA score and was deemed the best fit model. In addition, TD was also the only variable able to discriminate between mild impairment and moderate-to severe impairment. For the reach-to-grasp task, stroke patients with mild impairment and those with moderate-to-severe impairment exhibited ≤10.2 cm and >10.2 cm of TD respectively.

* **Verheyden, et al., (2008)** Positive outcomes from trunk restraint research suggest that restraining the trunk may help to "unmask" the latent potential for recovery of the affected upper extremity. The author postulates that improving active trunk control in post stroke will aid trunk stabilization and that may lead to improvement in upper extremity function. One of the objectives of this study is to investigate the association between trunk control and upper extremity function post stroke.

* **Dounskaia, (2007)** It remains unknown how the degree of trunk impairment post stroke will affect or contribute to the amount of trunk movement in reaching and grasping tasks for stroke patients with different levels of upper extremity control. Hence, there is still a gap in knowledge in this aspect.

* **Cirstea & Levin, (2007)** conducted an experimental study on stroke patients , have confirmed the presence of deficits in inter joint coordination during pointing and reaching tasks following stroke. Movements of the affected upper extremity in individuals with stroke are segmented, slower, and characterized by a greater variability and by deflection of the trajectory. Abnormal muscle co-activation and abnormal joint torque production in the paretic shoulder and elbow also account for the difficulty faced by stroke patients during pointing and reaching to targets (Liu et al. 2013).

* **Hlustík& Mayer, 2006; Lang, et al., (2006)** their studies discuss about distal arm muscles are more severely impaired than those of proximal muscles. During reaching training in the clinics, particularly in the very early phase post stroke, therapists may be inclined to facilitate scapula, shoulder and elbow movements toward the targets with lesser emphasis on hand opening and grasping components. This is in part due to the challenges of controlling numerous degrees of freedom of the shoulder, elbow, wrist and hand; and facilitating the movement components of the upper extremity simultaneously, especially in the presence of finger spasticity. With more training of the proximal muscles versus the distal muscles, it may further enhance the natural competition between the shoulder and hand representation in the cortex, possibly leading to larger shoulder representation area. Hence, this may be detrimental to recovery of the hand. A systematic review suggests that most therapeutic effects are mainly driven by improvements in proximal motor control, whereas improvements for hand recovery are poor (Langhorne et al. 2009)

* **Michaelsen, et al., (2004)** Conducted an experimental study on chronic stroke patients in that, the key findings highlight the presence of excessive compensatory trunk movements during pointing and reaching in stroke patients. They have concluded that the increased recruitment of trunk movement is a compensatory motor strategy by which the central nervous system may extend the reach of the arm when there is impaired joint movements and control of the upper extremity. The redundancy in the number of degrees of freedom of the motor system enables completion of tasks by substitution of other degrees of freedom for movements of impaired joints or control of the extremities However, the recruitment of the trunk during forward reach may not result in improved occupational performance because from an optimal control framework, the energy demands of trunk flexion would be greater than using the arm due to higher inertia.

* **Mindy F Levin, Johanne Desrosiers, et al., (2004)** conducted a movement analysis study to describe the development of a the Reaching Performance Scale (RPS)—for assessing compensatory movements for upper-extremity reaching in post stroke patients, and the results revealed that The RPS scores correlated with measurements of grip force and Chedoke-McMaster Stroke Assessment and Upper Extremity Performance Test for the Elderly (TEMPA) scores.. Mean kappa values on individual scale components for 3 raters represented a mean of 67% (SD=13.5%).

* **Ching Lin Hsieh, et al., (2002)** a prospective study conducted at college of medicine , National Taiwan University, Taiwan among 169 stroke patients to assess the relationship between trunk control at an early stage comprehensive ADL function in patients at 6 months after stroke. The finding of this study provides strong evidence of the predictive value of trunk control on comprehensive ADL function in stroke patients. The results imply that early assessment and management of trunk control after stroke should be emphasized.

* **Spencer, et al., 2000; Hopkins, et al., (2002)** Drawing from the findings from developmental science, it is evident that trunk control has an impact on the quality of reaching. Inferring from this, trunk control is essential for appropriate dissociation of the upper extremity from the trunk for function. As the reaching task will cause postural perturbation as the upper extremity moves, appropriate postural adjustments are essential to counteract such perturbation. By having a stable base or platform, in the form of good trunk control, it will facilitate various musculatures of the distal and proximal segments of the upper extremity to work against a background of trunk stability, hence enabling the ability of the upper extremity for function.

CHAPTER III

MATERIALS AND METHODS

3.1MATERIALS:

* A steel stool of 42cms of height
* Table of 72cms height
* Cylindrical object
* Camera
* Stop watch

3.2 STUDY DESIGN:

Cross sectional study design

3.3 STUDY SETTING:

Department of Neurology and Stroke Rehabilitation Centre, PSG IMS&R Hospitals, Coimbatore.

3.4 HUMAN PARTICIPATION PROTECTION:

The study was reviewed and approved by Institutional Human Ethics Committee, PSG IMS&R.

3.5 POPULATION/PARTICIPANTS:

Participants with hemi paresis from PSG IMS&R Hospitals were chosen as population for the study. A total of 30 hemi paretic participants were included in the study.

3.6 SAMPLING:

Convenience sampling

3.7INTERVENTION:

Not applicable

3.8 CRITERIA FOR SAMPLE SELECTION

3.8.1 Inclusion Criteria:

* First episode of MCA stroke.
* Age between 40-60 years.
* Post stroke duration within 1 year.
* Medically stable patients.
* Mini mental state examination score of 23 or above.
* Fuglmeyer motor upper extremity assessment score of 50 and above.
* Composite spasticity index for elbow < 7
* Patient should be able to follow the commands.
* Patient able to do the reaching task used in the test.
* Patient who gives informed consent to participate in the study.

3.8.2 Exclusion Criteria:

* Visual defects.
* Other neurological and orthopedic and cardiovascular conditions that affected the reaching activity.

3.9 STUDY DURATION:-

Total duration of 8 months was adopted for this study.

3.10 INSTRUMENT& TOOL FOR DATA COLLECTION:

- Reaching performance scale
- Trunk impairment scale.

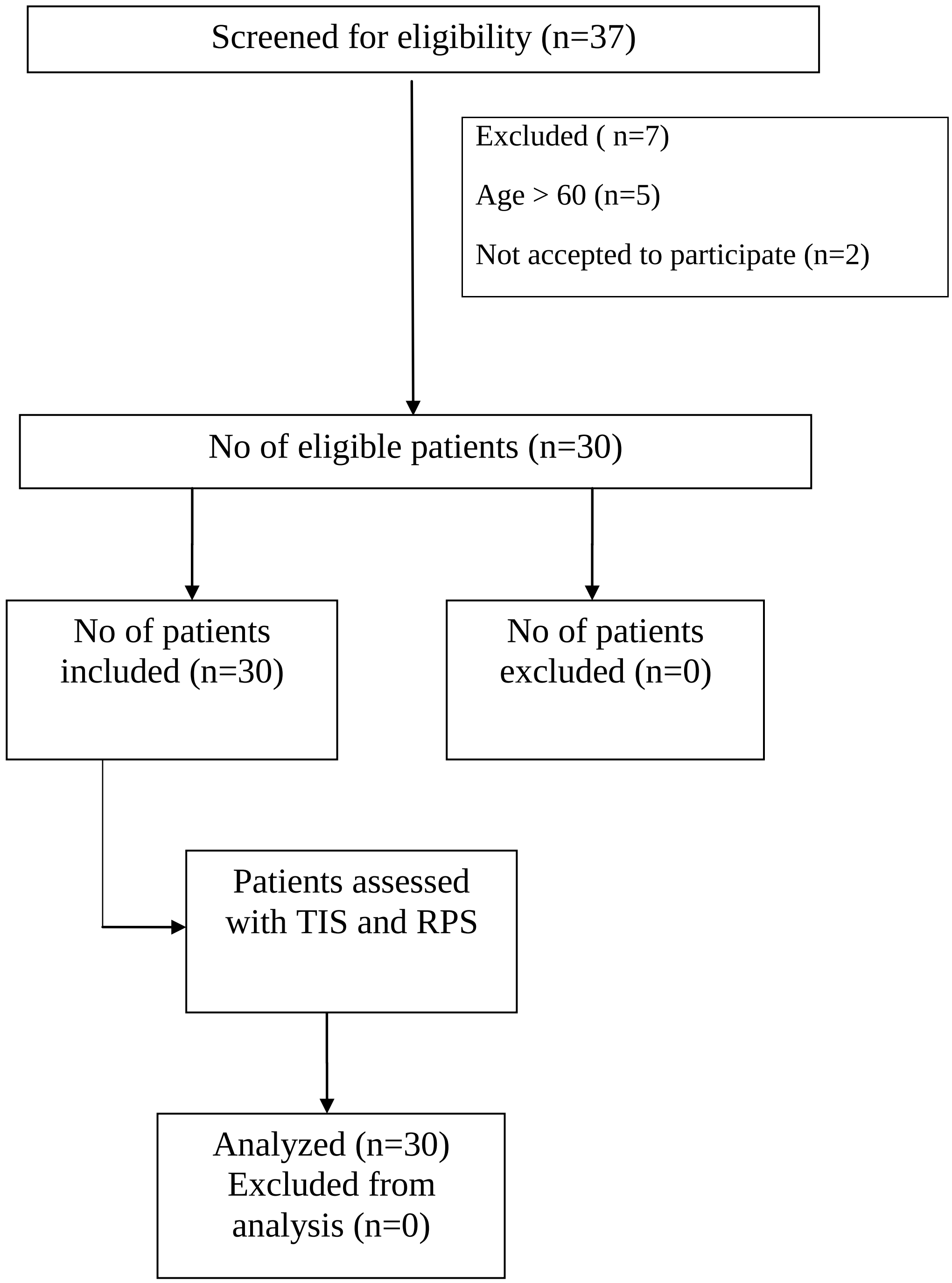
3.11 TECHNIQUE OF DATA COLLECTION:

Patient was assessed for eligibility based on the inclusion and exclusion criteria. Eligible patients were assessed for trunk impairment and reaching for near and far object on a stable surface. Then the same test was repeated by making the patient to sit on a foam pad which provides altered sensation and unstable condition.

During the Reaching task, participant was seated in a chair with a seat height of 42 cm and with a no backrest and armrests while facing a table with a height of 72 cm. The chair was placed at a distance equal to the length of the participant’s fully extended arm so that the distal crease of the wrist was aligned with a mark placed 4 cm from the front edge of the table. The participant sat up straight on the chair and with both feet placed flat on the floor. Initially, both arms were held alongside the body and were not supported on either the table or the participant’s lap. The task involved reaching and grasping a cylindrical object (7-cm base, 17.5 cm high) placed on the table in the midline of the trunk, 1 cm (close target) or30 cm (far target) from the front edge of the table.

Only the reach-to-grasp component of the task and not the transport of the cone after grasping was assessed because the scale was designed to be an impairment scale assessing the impairment of reaching and not the functional disability associated with object manipulation.

SCHEMATIC REPRESENTATION OF FLOW OF PARTICIPANTS



3.12 TECHNIQUE OF DATA ANALYSIS & INTERPRETATION:

- Data collected from subjects were analyzed using **Paired 't' test** to measure difference in trunk control on stable and unstable condition
- And also To find the difference in upper limb kinematics in reaching on stable and unstable condition
- **Pearson correlation coefficient** was used to measure the relation between trunk impairment and upper limb kinematics during reaching on stable and unstable condition. All these statistical analysis was done using SPSS 25.0.

Paired 't' test

$$SD = \sqrt{\frac{\sum (d - \bar{d})^2}{n-1}}$$

$$t = \frac{\bar{d}\sqrt{n}}{SD}$$

$\bar{d}$ = Calculated Mean Difference of stroke and age matched healthy subject values

SD = Standard Deviation

n = Number of samples

d = Difference between stroke and age matched healthy subject values

TABLE: 1

CLINICAL CHARACTERISTICS OF THE SUBJECTS (N=30)

CHARACTERISTICS	VALUE
Age in years (mean ± SD)	53.7 ± 6
Post Stroke Duration (months)	8.07±2
Gender(Male/Female)	28 (93%) /2 (7%)
Stroke Lesion	(Ischemic)
Hemi paretic side(Right/Left)	22 (73%)/8 (27%)

TABLE: 2

TRUNK IMPAIRMENT SCALE, REACHING NEAR AND FAR IN STABLE AND UNSTABLE VALUES OF STROKE SUBJECTS. (N = 30)

S. No	TIS	RPS near stable	RPS near unstable	RPS far stable	RPS far unstable
1	22	18	17	18	16
2	23	18	18	17	13
3	23	17	17	17	16
4	22	15	13	15	14
5	10	10	8	8	8
6	14	16	15	13	13
7	22	18	17	18	16
8	23	17	17	17	16
9	17	18	17	18	15
10	11	3	1	1	1
11	17	8	8	7	7
12	20	5	4	5	3
13	22	18	17	17	15
14	23	18	18	18	17
15	17	16	12	16	12
16	17	7	7	7	6

17	22	18	17	18	16
18	11	15	14	12	11
19	17	7	5	5	3
20	4	5	3	4	3
21	17	16	15	14	14
22	9	5	4	4	4
23	22	17	16	17	16
24	23	18	18	18	17
25	20	17	17	17	16
26	20	18	17	17	15
27	17	8	8	7	6
28	20	18	18	17	12
29	9	5	4	5	3
30	7	3	3	1	0

CHAPTER – IV

DATA ANALAYSIS AND INTERPRETATION

* Data analysis is the systemic organization and synthesis of research data and testing of research hypothesis using these data. Interpretation is the process of making sense of the results of a study and examining the implication (Polit & Belt, 2004). Post stroke patients were assessed with trunk impairment scale and reaching performance analysis. The mean, standard deviation and paired 't' test values were used **to identify the difference in trunk control on stable and unstable condition** And also **to find the difference in upper limb kinematics in reaching on stable and unstable condition**

* The Pearson's correlation coefficient 'r' value is used to **measure the strength of relationship between trunk impairment and upper limb kinematics during reaching on stable and unstable condition.**

TABLE: 3

COMPARISON OF TIS AND RPS ON STABLE AND UNSTABLE CONDITION

SCALES	N	Mean	Standard Deviation	't' Value	'p' Value
TRUNK IMPAIRMENT Stable unstable	30	17.37 16.63	5.537 5.295	3.832	P<0.05
RPS NEAR Stable unstable	30	13.07 12.17	5.681 5.884	5.341	P<0.05
RPS FAR Stable Unstable	30	12.27 10.80	6.023 5.641	6.416	P<0.05

Based on Table 3, the mean of trunk impairment in stable and unstable condition was found to be 17.37 and 16.63 respectively, standard deviation was 5.537 and 5.295, paired 't' test value was 3.832, at P<0.05. the mean of RPS reaching near object in stable and unstable condition was found to be 13.07 And 12.17 respectively, standard deviation was 5.681 and 5.884, paired 't' test value was 5.341, at P<0.05. the mean of RPS reaching far object in stable and unstable condition was found to be 12.27 and 10.80 respectively, standard deviation was 6.023 And 5.641, paired 't' test value was 6.416, at P<0.05.

GRAPH: 1

GRAPHICAL REPRESENTATION OF MEAN VALUE OF TRUNK IMPAIRMENT SCALE AND UPPER LIMB KINEMATICS IN REACHING UNDER ALTERED SENSATION IN STROKE SUBJECTS

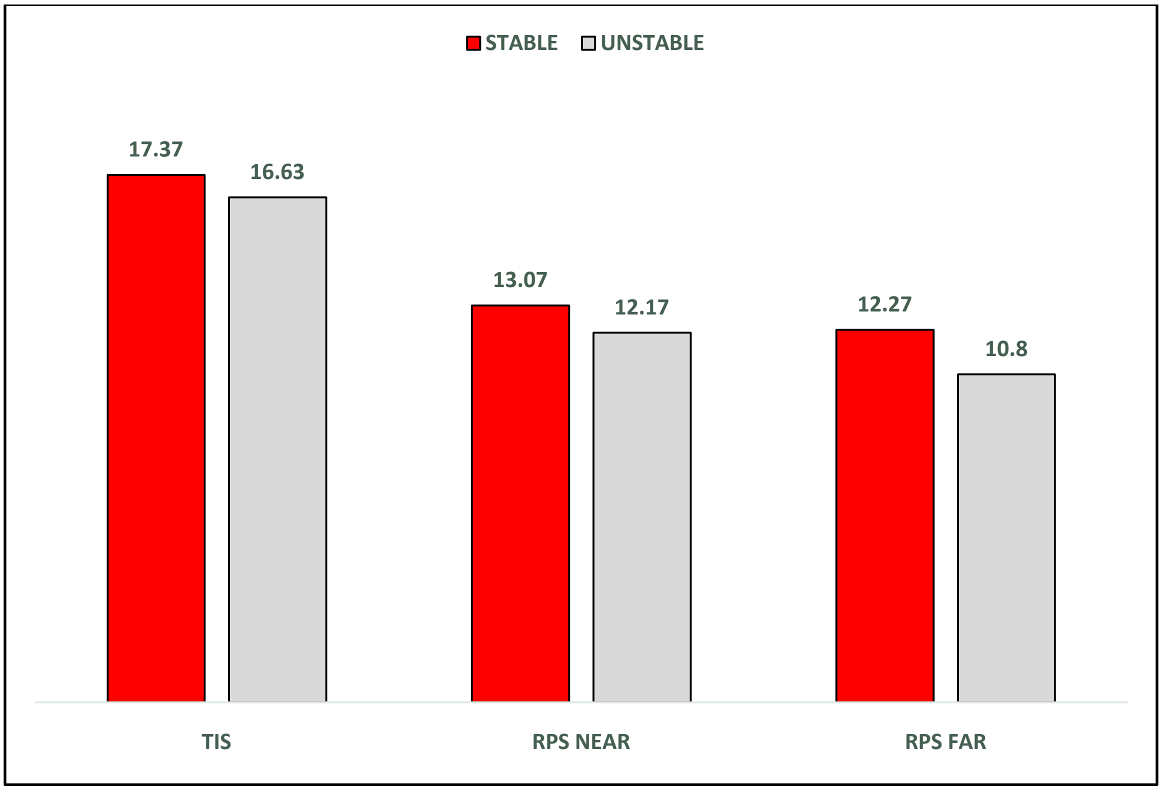


TABLE: 4

CORRELATIONS OF REACHING PERFORMANCE SCALE (RPS) SCORES WITH TRUNK IMPAIRMENT SCORES IN STROKE SUBJECTS

VARIABLES	NEAR REACH-STABLE	FAR REACH-STABLE	NEAR REACH-UNSTABLE	FAR REACH-UNSTABLE
Trunk Impairment score 'r'	.743**	.789**	.765**	.769**
Significance (2 tailed) 'p'	<0.05	<0.05	<0.05	<0.05

****Correlation is significant at the 0.01 level (2 –tailed)**

Based on Table 4, A Pearson product-moment correlation analysis shows that there is a strong, positive correlation between trunk impairment score and, upper limb kinematics, which includes reaching near object in stable ($r=0.743$, $p<0.05$), reaching far object in stable ($r=0.789$, $p<0.05$), reaching near object in unstable ($r=0.765$, $p<0.05$) and reaching far object in stable ($r=0.769$, $p<0.05$) with trunk impairment variable, which is statistically significant.

TABLE: 5

PEARSON CORRELATION RESULTS FOR TRUNK IMPAIRMENT SCORE AND COMPONENTS OF REACHING PERFORMANCE SCORES IN STROKE SUBJECTS

VARIABLES	Trunk movements	Elbow movements
Trunk Impairment score ‘r’	.847**	.779**
Significance (2 tailed) ‘p’	<0.05	<0.05

Table 5 shows,

* Relation between the trunk impairment and trunk movement of RPS, showed r= 0.847 the correlation is significant at 0.01 level.
* Relation between the trunk impairment and elbow movement of RPS, showed r= 0.779 the correlation is significant at 0.01 level.

TABLE: 6

RELATION BETWEEN TRUNK AND ELBOW MOVEMENTS IN REACHING PERFORMANCE SCALE

Upper limb kinematics	Elbow movements
Trunk movements ‘r’	.905**
Significance (2 tailed) ‘p’	<0.05

Table 6 shows,

* Relation between the trunk movement and elbow movement of RPS , showed r= 0.905 the correlation is significant at 0.01 level

CHAPTER V

RESULTS AND DISCUSSION

A total of 30 participants including 28 male and 2 female subjects successfully completed the reaching task involved in the study. In trunk impairment scale, stroke subjects with severe impairment used excessive forward flexion in concern with stable and unstable condition and the mean value was found to be 17.37 and 16.63 respectively. the mean of RPS reaching near object in stable and unstable condition was found to be 13.07 And 12.17 respectively reveals that during reaching near object task ,during reaching towards far object , patients trajectory towards the object showed the pathological couplings between the shoulder and elbow reduce the number of degrees of freedom in the paretic upper limb than the near object and the mean of RPS reaching far object in stable and unstable condition was found to be 12.27 and 10.80 respectively.

The calculated ‘t’ value using paired test between trunk impairment and upper limb kinematics of near and far object under altered sensation were 3.832, 5.341 and 6.416 respectively, which was greater than table ‘t’ value of 2.093 at $P<0.05$

A significant strong positive correlation was found between trunk impairment and upper limb kinematics in reaching performance scores. There is a strong positive correlation between Trunk impairment score and upper limb kinematics in reaching scores ($r = .789$ with $p< 0.05$), There is also a strong positive correlation between trunk impairment score and fourth component –elbow movement of reaching performance score ($r = .779$ with $p< 0.05$).These results shows that, stroke subjects with high score on the trunk impairment will tend to have high score on reaching performance scale under altered conditions.

FINDINGS IN THE CURRENT STUDY,

In this study, the relationship between the trunk impairment and upper limb kinematics through reaching task under altered conditions (stable and unstable) in stroke survivors was examined. The important findings are that Excessive trunk displacement (TD) as forward flexion, lateral flexion and rotation occurred in reaching task at unstable condition . In addition, reaching performance scoring have also confirmed the presence of deficits in inter joint coordination during pointing and reaching tasks following stroke.

And also movements of the affected upper extremity are segmented, slower, and characterized by a greater variability and by deflection of the trajectory from a straight line, reaching the far target in unstable surface led to deterioration of reaching performance.

A study on developmental science reveals that emerging postural control of trunk play an important in the onset of successful reaching **(Thelen& Spencer 1998)**. A recent longitudinal study confirmed a strong correlation between the development of trunk control and reaching performance in infants **(Rachwani et al. 2015)**.

Thereby current study emphasized that trunk impairment significantly correlated with reaching performance scale and proved that trunk control has an impact on the quality of reaching performance in stroke subjects.

Studies examining patients with stroke reported a reducing in trunk stability while performing upper extremity movements [5],therefore recent studies concluded that “trunk is considered an important postural stabilizer which enables the dissociation of the upper and lower extremities from the trunk for function. However, according to **(Heyrman et al. 2013)**,this common assumption in neuro rehabilitation has not been validated in clinical trials. Hence, the association of trunk control with upper extremity function in people with stroke was unknown to date. This knowledge is critical to the design of targeted cross sectional study for the trunk and upper extremity so that optimal outcome measures to identify the compensatory movements for stroke patients can be achieved.

Variety of studies investigated the effect of trunk stability on unstable platform. **(Verheyden et al2007)** concluded that Providing Altered sensation during reaching task with stable and unstable condition will cause postural perturbation as the upper extremity moves[9], hence appropriate postural adjustments are essential to counteract such perturbation. **(Zarahn et al. 2011)** stated thatby having a stable base or platform, in the form of good trunk control, it will facilitate various musculatures of the distal and proximal segments of the upper extremity to work against a background of trunk stability, hence enabling the ability of the upper extremity for optimal function.

In the current study , the relation between trunk and upper extremity kinematics was analyzed under alter sensation, patients with severe trunk impairment exhibit excessive trunk and shoulder girdle movements during pointing tasks, reach-to-grasp movement in unstable condition .

The RPS scale used in this study evaluates 6 components. Four components are related to reaching close and far targets: trunk displacement, movement smoothness, shoulder movements, and elbow movements. The 2 additional components globally rate the quality of prehension and the accomplishment of the task. The focus of each item is separate, the reaching movement was divided into its elements visually (trunk displacement, movement smoothness, shoulder displacement, elbow displacement, and quality of prehension) even though the elements are changing together [1].

(Krebs et al. 2012) stated that stable trunk provides a solid foundation for the torque generated by the extremities. Performing a reaching movement on a stable surface is different from the challenges faced when attempting to reach for objects while balancing on an unstable surface[13].similarly in the current study ,it was found that patients faced difficulty while reaching on unstable condition

Studies have demonstrated that unstable conditions can lead to decreased force output and muscle activation of the extremities[10]. Thereby , first component, trunk displacement, during near object reaching ,subjects showed almost no compensatory anterior trunk displacement in both stable and unstable condition in accordance their trunk impairment level and subjects used excessive forward trunk displacement with almost full extension of the elbow for reaches to the far target due to altered sensation provided to them.

For the second component, movement smoothness, subjects showed several segmented arm and trunk movements while reaching far target in unstable surface than reaching near objects.

The third component, shoulder movements, subjects with severe trunk impairment showed excessive flexion and horizontal adduction of the shoulder and excessive scapular elevation while reaching at unstable condition.

In addition to shoulder component subjects with less trunk impairment showed Adequate flexion of approximately 20 degrees for the near target and 40 degrees for the far target, while approximately 40 degrees of shoulder adduction was noted for each target to bring the arm to the sagittal midline.

For the fourth component, elbow movements, the highest rating of 3 is given if adequate elbow extension is produced to reach the target. Lower scores are given if the participant is unable to use, or uses less than adequate, elbow extension to move the hand to the target. Approximately 80 and 100 degrees of elbow extension was found for the near and far targets, respectively. Reduced elbow extension was accompanied with excessive compensatory trunk movement in many participants with residual synergy. However with overall population trunk impairment and elbow movements during reaching was strongly correlated with a, r value of, ($r = 0.779$).

According to some authors**(M.C.Cristea et al 2000)** , the use of compensatory strategy may be related to the degree of motor impairment, severely to moderately impaired subjects recruited new degree of freedom to compensate for their motor deficits, while mildly impaired subjects tended to employ healthy movement [3].

(Mindy F Levin, Johanne Desrosiers et al 2004) conducted an study on validation of RPS and validated that for the 2 global ratings, highest scores are given for accomplishment of the task without the use of compensatory strategies. For component 5, prehension, "task accomplishment" implies adequate hand opening and closing, most of the subjects used compensatory grasping strategies (winding fingers around a cone, downward grasping)[1], in some patients prehension was not possible at all. For component 6, global score, "task accomplishment" implies the production of a smooth and direct movement. Although component 6 may be related to the first 5 components, our purpose was to have an idea of the successful accomplishment of the task itself and the global quality of the movement, our patients scored overall less score in reaching far object in unstable surface.

The emphasis in current neuro rehabilitation practice is on the rapid establishment of independence in activities of daily living through compensatory strategies, rather than on the reduction of impairment **(Kitago&Krakauer 2013)**. In view of possible detrimental effects of compensatory strategies on recovery, this study will help the rehabilitation professionals to identify the compensatory movements of trunk and upper extremity, while performing upper limb task and also ensure them to adopt a remediation approach rather than compensatory approach in rehabilitation therapy.

LIMITATIONS OF THE STUDY:

1. Some of the participants were asked to repeat failed trials that may cause training effects.
2. Sample size is small
3. No blinding was done

SUGGESTIONS FOR FUTURE RESEARCH:

1. Future studies involving identification of factors to predict reaching performance in chronic stroke patients is recommended.
2. Future research involving task oriented approach with reaching training in stroke rehabilitation is recommended.
3. A study with large sample size is recommended.

CHAPTER VI

SUMMARY AND CONCLUSION

The results of the study concluded that severe trunk impairment led to compensatory trunk and arm movements while performing reaching task under altered condition. Also, the impairment of trunk following stroke is associated with a decline in the reaching performance.

Hence, it is recommended that trunk control and upper limb kinematics under altered condition can be used asa measure of functional performance in stroke subjects.

Also, it is recommended to facilitate trunk control training and functional upper limb training by eliminating the compensatory strategies adopted by stroke patients in their period of rehabilitation.

This study concludes that **"There is significant difference in trunk control and upper limb kinematics in reaching on stable and unstable condition and there is significant correlation between trunk impairment and upper limb kinematics during reaching on stable and unstable conditionin stroke subjects"**

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ANNEXURE I

PSG Institute of Medical Sciences & Research
Institutional Human Ethics Committee
Recognized by The Strategic Initiative for Developing Capacity in Ethical Review (SIDCER)
POST BOX NO. 1674, PEELAMEDU, COIMBATORE 641 004, TAMIL NADU, INDIA
Phone : 91 422 - 2598822, 2570170, Fax : 91 422 - 2594400, Email : ihec@psgimsr.ac.in

Ms A Vijayalakshmi
I year MPT
Guide: Mr J Raja Regan / Mr R Mahesh
PSG College of Physiotherapy
Coimbatore

Ref: Project No.17/151

Date: August 8, 2017,

Dear Ms Vijayalakshmi

Institutional Human Ethics Committee, PSG IMS&R reviewed and discussed your application dated 24.04.2017 to conduct the research study entitled *"Relation between trunk impairment and upper limb kinematics of reaching near and far object under altered sensation in post-stroke patients"* during the IHEC meeting held on 02.06.2017.

The following documents were reviewed and approved:

1. Project submission form
2. Study protocol (Version 1 dated 24.04.2017)
3. Informed consent forms (Version 2 dated 08.08.2017)
4. Data collection tool (Version 2 dated 08.08.2017
5. Permission letter from concerned Heads of Department
6. Current CVs of Principal investigator, Co-investigator
7. Budget

The following members of the Institutional Human Ethics Committee (IHEC) were present at the meeting held on 02.06.2017 at IHEC Secretariat, PSG IMS & R between 10.00 am and 11.00 am:

Sl. No.	Name of the Member of IHEC	Qualification	Area of Expertise	Gender	Affiliation to the Institution Yes/No	Present at the meeting Yes/No
1	Mr R Nandakumar (Chairperson, IHEC)	BA., BL	Legal Expert	Male	No	Yes
2	Dr. S. Bhuvaneshwari (Member-Secretary, IHEC)	MD	Clinical Pharmacology	Female	Yes	Yes
3	Dr S Shanthakumari	MD	Pathology, Ethicist	Female	Yes	Yes
4	Dr Sudha Ramalingam	MD	Epidemiologist, Ethicist Alt. member-Secretary	Female	Yes	Yes
5	Dr D Vijaya	M Sc., Ph D	Basic Medical Sciences (Biochemistry)	Female	Yes	Yes

The study is approved in its presented form. The decision was arrived at through consensus. Neither PI nor any of proposed study team members were present during the decision making of the IHEC. The IHEC functions in accordance with the ICH-GCP/ICMR/Schedule Y guidelines. The approval is valid until one year from the date of sanction. You may make a written request for renewal / extension of the validity, along with the submission of status report as decided by the IHEC.

PSG Institute of Medical Sciences & Research
Institutional Human Ethics Committee
Recognized by The Strategic Initiative for Developing Capacity in Ethical Review (SIDCER)
POST BOX NO. 1674, PEELAMEDU, COIMBATORE 641 004, TAMIL NADU, INDIA
Phone : 91 422 - 2598822, 2570170, Fax : 91 422 - 2594400, Email : ihec@psgimsr.ac.in

Following points must be noted:

1. IHEC should be informed of the date of initiation of the study
2. Status report of the study should be submitted to the IHEC every 12 months
3. PI and other investigators should co-operate fully with IHEC, who will monitor the trial from time to time
4. At the time of PI's retirement/intention to leave the institute, study responsibility should be transferred to a colleague after obtaining clearance from HOD, Status report, including accounts details should be submitted to IHEC and extramural sponsors
5. In case of any new information or any SAE, which could affect any study, must be informed to IHEC and sponsors. The PI should report SAEs occurred for IHEC approved studies within 7 days of the occurrence of the SAE. If the SAE is 'Death', the IHEC Secretariat will receive the SAE reporting form within 24 hours of the occurrence
6. In the event of any protocol amendments, IHEC must be informed and the amendments should be highlighted in clear terms as follows:
   a. The exact alteration/amendment should be specified and indicated where the amendment occurred in the original project. (Page no. Clause no. etc.)
   b. Alteration in the budgetary status should be clearly indicated and the revised budget form should be submitted
   c. If the amendments require a change in the consent form, the copy of revised Consent Form should be submitted to Ethics Committee for approval
   d. If the amendment demands a re-look at the toxicity or side effects to patients, the same should be documented
   e. If there are any amendments in the trial design, these must be incorporated in the protocol, and other study documents. These revised documents should be submitted for approval of the IHEC and only then can they be implemented
   f. Any deviation-Violation/waiver in the protocol must be informed to the IHEC within the stipulated period for review
7. Final report along with summary of findings and presentations/publications if any on closure of the study should be submitted to IHEC

Kindly note this approval is subject to ratification in the forthcoming full board review meeting of the IHEC.

Thanking You,

Yours Sincerely,

SECRETARY
PSG IMS&R
COIMBATORE-641004
INSTITUTIONAL HUMAN ETHICS COMMITTEE

Dr S Bhuvaneshwari
Member - Secretary
Institutional Human Ethics Committee

ANNEXURE II

NEUROLOGICAL ASSESSMENT FORM FOR STROKE

SUBJECTIVE EXAMINATION

DEMOGRAPHIC DATA

Name: OP/IP No:

Age: Address:

Gender: Date:

Handedness: Phone /Mobile No:

Referred by: Assessed by:

Post Stroke Duration:

Composite spasticity index:

MMSE score:

PATIENT HISTORY

Pathology: Vascular territory: MCA

Chief complaints:

History of present illness:

Past medical and surgical history:

Social History:

Personal History:

Family History:

Risk factors:

Occupational History:

Historyof Living Environment:

Previous Functional Status:

Pain History

Side :

Site :

Onset :

Duration :

Type :

Aggravating factors :

Relieving factors :

Intensity :

Vital signs

Temperature :

Blood pressure :

Heart rate :

Respiratory rate :

OBJECTIVE EXAMINATION

ON OBSERVATION

Built:	Posture:
Attitude of limbs:	Muscle wasting:
Pattern of movement:	Gait:
Pressure sore:	Edema:
Tropical changes:	External appliances:

On Palpation

Tone :

Edema :

Tenderness :

Warmth :

Other palpatory findings:

1. HIGHER MENTAL FUNCTION

Level of consciousness

Orientation

Person :

Place :

Time :

Memory

Immediate :

Recent :

Remote :

Attention :

Communication :

Emotional status :

2. HIGHER CORICAL FUNCTIONS

Cognition

Fund of knowledge

Calculation

Proverb interpretation

Perception

Body scheme /body image :

Spatial relation :

Agnosia :

Apraxia :

3. SENSORY INTEGRITY

Superficial :

Deep :

Combined cortical :

4. CRANIAL NERVE INTEGRITY

5. MOTOR SYSTEM

Muscle tone :

Muscle power :

Voluntary motor control :

6. REFLEXES

Superficial reflexes :

Abdominal :

Plantar :

Deep tendon reflexes

Myotatic reflex	**Right**	**Left**
Biceps		
Brachioradialis		
Triceps		
Pectoral		
Finger flexors		
Quadriceps		
Achilles		

7. BALANCE
Sitting
Standing

BALANCE REACTIONS

BALANCE STRATEGIES

8. ASSOCIATED REACTIONS

9. INVOLUNTARY MOVEMENTS

10. CO-ORDINATION
Non equilibrium:
Equilibrium**:**
11. HAND FUNCTIONS

12. GAIT

13. ASSISTIVE DEVICES

14. OTHER SYSTEMS
Pulmonary :
Musculoskeletal :
Integumentary :
Cardiovascular :
Bladder and Bowel :

15. FUNCTIONAL STATUS

Bed mobility :

Transfer :

ADL :

INVESTIGATIONS AND FINDINGS

MEDICAL DIAGNOSIS

ANNEXURE – III

PROFORMA

Patient Name: IP/ OP No:

Age: Contact No:

Sex: Date of Assessment:

Occupation:

Address:

Handedness:

Diagnosis:

Post Stroke Duration:

Vitals**: BP:** mmHg **HR:** Bpm **RR:** bpm **Temp:** ◦C

Composite spasticity index:

MMSE score:

OUTCOME MEASUREMENTS SCORING:

<table>
<tr><th rowspan="2">S.NO</th><th rowspan="2" colspan="2">OUTCOME MEASURES</th><th colspan="2">SCORES</th></tr>
<tr><th>Stable</th><th>Unstable</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">REACHING PERFORMANCE SCALE</td><td>Near object</td><td></td><td></td></tr>
<tr><td>Far object</td><td></td><td></td></tr>
<tr><td>2</td><td colspan="2">TRUNK IMPAIRMENT SCALE</td><td></td><td></td></tr>
<tr><td rowspan="2">3</td><td rowspan="2" colspan="2">TIME TAKEN TO COMPLETE THE REACHING TASK</td><td>Near object</td><td>Far object</td></tr>
<tr><td></td><td></td></tr>
</table>

DATE: PI’s SIGNATURE:

ANNEXURE –IV

INFORMED CONSENT FOR PARTICIPATION IN RESEARCH

STUDYPATIENT INFORMATION FORM

PSG Institute of Medical Science and Research, Coimbatore
Institutional Human Ethics Committee
INFORMED CONSENT FORMAT FOR RESEARCH PROJECTS

I Vijayalakshmi. A, am carrying out a study on the topic: **"RELATION BETWEEN TRUNK IMPAIRMENT AND UPPER LIMB KINEMATICS OF REACHING NEAR AND FAR OBJECT UNDER ALTERED SENSATION IN POST STROKE PATIENTS",** as part of my research project being carried out under the aegis of the Departments of: Neurology, Physical medicine and rehabilitation.

My research guide is: Prof. R.Mahesh, MPT (Cardio Respiratory).

The justification for this study is:
Reaching activity is considered as a prerequisite for daily activities, following Stroke . It has been shown that proximal stability allows for independent use of the arms and hands in manipulative and purposeful activity in post stroke patients, Trunk control plays an important role in performance of functional activities such as reaching. Achieving the function using compensatory pattern will result in learning abnormal pattern and atypical movement which is not recommended for patient with potential for recovery. It is important to analyze the kinematics of the upper limb during functional task so that the abnormal pattern can be identified and normal pattern can be rehabilitated. Moreover, in literatures trunk control and upper limb functions were tested in stable conditions but in day today life patient has to experience many unstable conditions. Therefore, it is important to find the relation between trunk impairment and kinematics of upper limb in unstable condition.

The objectives of this study:

- To find the difference in trunk control on stable and unstable condition.
- To find the difference in upper limb kinematics in reaching on stable and unstable condition.
- To find the relation between trunk impairment and upper limb kinematics during reaching on stable and unstable condition.

Sample size: 30

Study volunteers / participants are post stroke patients, 40-60 years of age.

Location: Department of Neurology, Department of PMR, PSG IMS&R Hospitals.

We request you to kindly cooperate with us in this study. We propose collect background information and other relevant details related to this study. We will be carrying out.

Initial interview: 15 minutes.

Final interview: 15 minutes

Data collected will be stored for a period of 5 years. We will not use the data as part of another study.

If **photograph** is taken: **YES**, without revealing the identity of yours. we want to publish in project book, conferences and journals.

Assessment session will be **videotaped** for scoring the reaching performance scale with your consent, and identity will be confidential

Clinical examination :**YES**

Blood sample collection: Specify quantity of blood being drawn: **___________** ml**. NOT**

APPLICABLE

No. of times it will be collected: **______________. NOT APPLICABLE**

Whether blood sample collection is part of routine procedure or for research (Study) purpose:

1Routine procedure   2.Research purpose   **NOT APPLICABLE**

Specify **purpose**, discomfort likely to be felt and side effects, if any**:__________ NOT APPLICABLE**

Whether blood sample collected will be stored after study period : Yes / No , it will be destroyed **NOT APPLICABLE**

Whether blood sample collected will be sold: **Yes / No NOT APPLICABLE**

Whether blood sample collected will be shared with persons from another institution: Yes / No **NOT APPLICABLE**

Medication given , if any, duration, side effects, purpose, benefits**: NOT APPLICABLE**

Whether medication given is part of routine procedures:Yes / No (if not, state reasons for giving this particular medication) **NOT APPLICABLE**

How the **results** will be used: The data collected during the study will be used without revealing your identity. Your identity will be confidential even if the results of the study are published.

Benefits from this study: The results of study will influence the importance of kinematics of upper limb as a part of functional assessment in post stroke patients. Also, the study will support the importance of upper limb and trunk control training under altered sensation conditions in rehabilitation of stroke patients.

Risks involved by participating in this study: There are no possible risks or discomforts will be experienced during this study. Fall may be the possible risk, in such instance, therapist will be stand near by the patient to prevent the fall.

If you are uncomfortable in answering any of our questions during the course of the interview, **you have the right to withdraw from the interview / study at anytime.** You have the freedom to withdraw from the study at any point of time. Kindly be assured that your refusal to participate or withdrawal at any stage, if you so decide, will not result in any form of compromise or discrimination in the services offered nor would it attract any penalty. You will continue to have access to the regular services offered to a patient. You will **NOT** be paid any remuneration for the time you spend with us for this interview / study. The information provided by you will be kept in strict confidence. Under no circumstances shall we reveal the identity of the respondent or their families to anyone. The information that we collect shall be used for approved research purposes only. You will be informed about any significant new findings - including adverse events, if any, – whether directly related to you or to other participants of this study, developed during the course of this research which may relate to your willingness to continue participation.

Consent: The above information regarding the study, has been read by me/ read to me, and has been explained to me by the investigator/s. Having understood the same, I hereby give my consent to them to interview me. I am affixing my signature / left thumb impression to indicate my consent and willingness to participate in this study (i.e., willingly abide by the project requirements).

Signature / Left thumb impression of the Study Volunteer / Legal Representative:

Signature of the Interviewer with date: Witness:

Contact number of PI: 8778104482

Contact number of Ethics Committee Office: 0422-4345818

INFORMED CONSENT FORM

STATEMENT OF THE PARTICIPANTS:

I……………………………have been explained in detail about the procedures to be carried out in the study.

I have been given opportunity to discuss and ask questions with the responsible Physiotherapist regarding the study.

I have understood that no harm to my ________ health by participating in this study.

I agree for my Consultant (neurologist) to be notified that I am taking part in the above study.

I agree to participate voluntarily in the study described in this form.

Name of Subject	Signature	Date
Name of Investigator	Signature	Date
Name of Witness	Signature	Date

பூசாகோமருத்துவக் கல்லூரிமற்றும் ஆராய்ச்சிநிறுவனம், கோவை

மனிதநெறிமுறைக் குழு

ஒப்புதல் படிவம்

தேதி :

பூ. சா. கோ மருத்துவக் கல்லூரி மற்றும் ஆராய்ச்சி நிறுவனம், கோவை

மனித நெறிமுறைக் குழு

ஒப்புதல் படிவம்

தேதி:

அ. விஜயலட்சுமி, ஆகிய நான்பூ. சா. கோ மருத்துவக் கல்லூரியின்/ மருத்துவமனையின்நரம்பியல்துறையின் கீழ், **“பக்கவாதத்தால் பாதிக்கப்பட்ட நோயாளிகள் ஒரு பொருள் / எல்லை நோக்கிய நகர்வின் போது மேல் கை மற்றும் உடற்பகுதியில் ஏற்படும் மாறுதல்களைக் கண்டறிதல்”** என்ற தலைப்பில் ஆய்வு மேற்கொள்ள உள்ளேன்.

என் ஆய்வு வழிகாட்டி:பேராசிரியர். திரு மகேஷ், முதல்வர், பூ. சா. கோ இயன்முறைமருத்துவக் கல்லூரி

ஆய்வு மேற்கொள்வதற்கான அடிப்படை:

பக்கவாதத்தால் பாதிக்கப்பட்டவர் தங்களின் முடங்கிய தசைகளின் இயக்கத்தை அதிகரிக்க தினமும் சில வழிமுறைகளைக் கையாள்வது அவசியம். முதுகு தண்டுவடம் இதற்கான செயல்பாட்டில் அதிகம் பங்கு வகிக்கிறது. சரியான நரம்பின் தூண்டுதலின் செயல்பாடுகளே நோயினை குறைக்க உதவும். தவறான தசையின் செயல்பாடுகள் அதிகரிப்பது மேலும் நோயின் தீவிரத்தை அதிகரிக்கும். அதன் பொருட்டு தண்டுவடம் மற்றும் உடலின் செயல்பாட்டோடு கூடிய முறையை வழிமுறைப்படுத்துவது நோயின் தீவிரத்தை குறைத்து அதனை குணப்படுத்தவும் உதவும். தண்டுவடம் மற்றும் உடலின் செயல்பாடுகளால் ஏற்படும் மாற்றங்களை கணித்து அதனை முறைப் படுத்துவதே ஆய்வின் அடிப்படை நோக்கம் ஆகும்.

ஆய்வின் நோக்கம்:

1. உடற்பகுதியின் நிலையான மற்றும் நிலையற்ற கட்டுப்பாட்டை ஆராய்தல்.
2. நிலையான மற்றும் நிலையற்ற மேல் கை செயல்பாடு ஒரு எல்லை / பொருளை நோக்கிய நகர்வின் போது ஏற்படும் மாற்றங்களை அளவிடுவது.
3. மேல் கை மற்றும் உடற்பகுதி செயல்பாட்டின் ஒருங்கினைந்த மற்றும் முரண்பாடான செயல்பாட்டை அளவிடுதல்.

ஆய்வில் பங்கு பெறும் நபர்களின் எண்ணிக்கை: 30

ஆய்வில்பங்கு பெறுவோர் மற்றும் வயது: 40 - 60 வயதுக்குட்பட்ட,பக்கவாத நோயாளிகள்.

ஆய்வு மேற்கொள்ளும் இடம்: நரம்பியல் துறை, புனர்வாழ்வு மருத்துவ துறை, பூ. சா. கோ. மருத்துவமனை, கோயம்புத்தூர்.

இந்த ஆய்வில் எங்களுடன் ஒத்துழைக்குமாறு கேட்டுக்கொள்கிறோம். நாங்கள் சில தகவல்களை இந்த ஆய்விற்காக சேகரிக்க உள்ளோம்.

ஆய்வு செய்யப்படும் முறை:

இந்த ஆய்வின் மொத்த கால அளவு 8 மாதங்கள். எனது ஆய்வில் பக்கவாதத்தால் பாதிக்கப்பட்ட தகுதியுள்ள நோயாளிகளை தேர்வு செய்துஅவர்களுக்கு முதலில் முதுகுதூண்வலுக்குறைவு மற்றும்பக்கம்மற்றும் தொலைவுப் பொருள் செயல்பாடு மதிப்பீடுகளை செயல்திறன் அளவிடும் அளவுகோல் (Reaching Performance Scale) கொண்டு அளவிடப்படும். பிறகு அதே சோதனை நுரை மெத்தை (Foam Pad) மீது உட்காரவைத்துமீண்டும்முதுகுதூண்வலுக்குறைவு அளவுகோல் (Trunk Impairment scale)மற்றும் செயல்திறன் அளவிடும் அளவுகோல் (Reaching Performance Scale) கொண்டும் அளவீடுகளை குறித்துக் கொண்டும், முதலில் எடுத்த அளவுகளுடன் ஒப்பிட்டு, இடைநிலை ஆற்றல் அளவிடப்படும்.

முதன்மை நேர்காணல்:15 நிமிடங்கள்

முடிவு நேர்காணல்: 15 நிமிடங்கள்

இந்த ஆய்வில் கிடைக்கும் தகவல்கள் **5 வருடங்கள்** பாதுகாக்கப்படும். இந்த தகவல்கள் வேறு ஆய்விற்குப் பயன்படுத்தப் பட மாட்டாது.

சுகாதாரக் கல்வி: அமர்வுகள்: வாரத்திற்கு ___ முறை ஒரு அமர்வுக்கான நேரம்: ___ நிமிடங்கள் **பொருந்தாது**

மருத்துவ பரிசோதனைகள்: உண்டு

இரத்த மாதிரி சேகரிப்பு: இல்லை

இரத்த மாதிரி எடுப்பதுவழக்கமான சிகிச்சைக்காகவோ அல்லது இந்த ஆய்விற்காகவோ:

பொருந்தாது

இதனால் ஏற்படக் கூடிய அசௌகரியங்கள் / பக்க விளைவுகள்: இதனால் எந்த அசௌகரியமோ, பக்க விளைவுகளோ ஏற்படாது.**பொருந்தாது**

இரத்த மாதிரிகள் ஆய்விற்குப்பின் பாதுகாத்து வைக்கப்படுமா? ஆம் / இல்லை, அழிக்கப்படும்: **பொருந்தாது**

சேகரிக்கப்பட்ட இரத்தம் விற்கப்படுமா? ஆம் / இல்லை **பொருந்தாது**

சேகரிக்கப்பட்ட இரத்தம் வேறு நிறுவனத்துடன் பகிர்ந்து கொள்ளப்படுமா? ஆம் / இல்லை: **பொருந்தாது**

மருந்துகள் ஏதேனும் கொடுக்கப்படவிருந்தால் அவை பற்றியவிவரம் (கொடுக்கப்படும் காரணம்,காலம், பக்க விளைவுகள், பயன்கள்): **பொருந்தாது**

மருந்துகள் கொடுக்கப்படுவதுவழக்கமான சிகிச்சை முறையா?: ஆம் / இல்லை (இல்லை என்றால்கொடுக்கப்படும் காரணம்) **பொருந்தாது**

கொடுக்கப்படும்மருந்துகளுக்குமாற்றுஉள்ளதா?: ஆம் / இல்லை (ஆம் என்றால் இந்த குறிப்பிட்ட மருந்து கொடுக்கப்படும் காரணம்) **பொருந்தாது**

ஆய்வில் பங்குபெறுவதால் ஏற்படும் பலன்கள்:

ஆய்வின் முடிவுகள் பக்கவாத நோயாளிகளின் மேல் கை இயக்கவடிவியலின் செயல்பாட்டினை மதிப்பிட உதவும். மேலும், ஆய்வின் நோக்கம் பக்கவாத நோயாளிகளின், மறுவாழ்வு நிலைமைகளின் கீழ், மேல் கை மற்றும் உடற்பகுதி கட்டுப்பாட்டுபயிற்சியின்முக்கியத்துவத்தை கண்டறிய பயன்படும்.

ஆய்வினால்பங்கேற்பதால் ஏற்படும் அசௌகரியங்கள் / பக்க விளைவுகள்: இந்த ஆய்வினால் தங்களுக்கு எந்த விதமான அபாயங்களும் அசௌகரியங்களும்ஏற்படாது. நோயாளி நுரை மெத்தையில் அமர்ந்துஇருக்கும்போது கீழே விழுவதற்கான வாய்ப்புகள் உண்டு. இதனை தவிர்க்க இயன்முறைமருத்துவர் உடன் இருப்பார்.

ஆய்வின் முடிவுகள் எந்த முறையில் பயன்படுத்தப்படும்?

இந்த ஆய்வின்மூலம் கிடைக்கும் தகவல்கள் தங்களின் புகைப்படத்துடன் தங்களின் அடையாளம் அறியாவண்ணம் அகநிலை அறிக்கை (Internal report), கலந்தாய்வுகள் (Conference)அறிவியல் சார்ந்த ஆராய்ச்சிப் பத்திரிக்கைகளில்(Journals)வெளியிடப்படும். இதற்கு தங்களின் அனுமதி கோருகிறேன்.

இந்த ஆய்வின் கேள்விகளுக்கு பதிலளிப்பதோ, இரத்த மாதிரிகள் அல்லது திசு மாதிரிகள் எடுப்பதிலோ உங்களுக்கு ஏதேனும் அசௌகரியங்கள் இருந்தால், எந்த நேரத்தில் வேண்டுமானாலும் ஆய்விலிருந்து விலகிக்கொள்ளும் உரிமை உங்களுக்கு உண்டு. ஆய்விலிருந்து விலகிக்கொள்வதால் உங்களுக்கு அளிக்கப்படும் சிகிச்சை முறையில் எந்த வித பாதிப்பும் இருக்காது என்று உங்களுக்கு உறுதியளிக்கிறோம். மருத்துவமனையில் நோயாளிகளுக்கு அளிக்கப்படும் சேவைகளை நீங்கள் தொடர்ந்து பெறலாம். இந்த ஆய்வில்பங்கேற்க ஒப்புக்கொள்ளுவதால் வேறு எந்த விதமான கூடுதலான பலனும் உங்களுக்குக் கிடைக்காது. நீங்கள் அளிக்கும் தகவல்கள் இரகசியமாக வைக்கப்படும். ஆய்வில்பங்கேற்பவர்கள் பற்றியோ அவர்கள் குடும்பத்தைப் பற்றியோ எந்தத் தகவலும் எக்காரணம் கொண்டும் வெளியிடப்படாது என்று உறுதியளிக்கிறோம். நீங்கள் அளிக்கும் தகவல்கள் / இரத்த மாதிரிகள் / திசு மாதிரிகள் அங்கீகரிக்கப்பட்ட ஆய்விற்குமட்டுமே பயன்படுத்தப்படும். இந்த ஆய்வு நடைபெறும் காலத்தில் குறிப்பிடத்தகுந்த புதிய கண்டுபிடிப்புகள் அல்லதுபக்க விளைவுகள் ஏதும் ஏற்பட்டால் உங்களுக்குத் தெரிவிக்கப்படும். இதனால் ஆய்வில் தொடர்ந்து பங்கு பெறுவது பற்றிய உங்கள் நிலைப்பாட்டை நீங்கள் தெரிவிக்க ஏதுவாகும்.

ஆய்வுக்குட்படுபவரின் ஒப்புதல்: இந்த ஆய்வைப்பற்றிய மேற்கூறிய தகவல்களை நான் படித்து அறிந்து கொண்டேன் / ஆய்வாளர் படிக்கக் கேட்டுத் தெரிந்து கொண்டேன். ஆய்வினைப்பற்றி நன்றாகப் புரிந்து கொண்டு இந்த ஆய்வில்பங்கு பெற ஒப்புக்கொள்கிறேன். இந்த ஆய்வில்பங்கேற்பதற்கான எனது ஒப்புதலை கீழே கையொப்பமிட்டு, கை ரேகை பதித்து நான் தெரிவித்துக் கொள்கிறேன்.

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ANNEXURE – V

ASSESSMENT TOOLS

TRUNK IMPAIRMENT SCALE

The starting position for each item is the same. The patient is sitting on the edge of a bed or treatment table without back and arm support. The thighs make full contact with the bed or table, the feet are hip width apart and placed flat on the floor. The knee angle is 90°. The arms rest on the legs. If hypertonia is present the position of the hemiplegic arm is taken as the starting position. The head and trunk are in a midline position.

If the patient scores 0 on the first item, the total score for the TIS is 0.

Each item of the test can be performed three times. The highest score counts. No practice session is allowed.

The patient can be corrected between the attempts.

The tests are verbally explained to the patient and can be demonstrated if needed.

Item			
	Static sitting balance		
1	Starting position	Patient falls or cannot maintain starting position for 10 seconds without arm support	☐ 0
		Patient can maintain starting position for 10 seconds	☐ 2
		If score = 0, then TIS total score = 0	
2	Starting position Therapist crosses the unaffected leg over the hemiplegic leg	Patient falls or cannot maintain sitting position for 10 seconds without arm support	☐ 0
		Patient can maintain sitting position for 10 seconds	☐ 2
3	Starting position Patient crosses the unaffected leg over the hemiplegic leg	Patient falls	☐ 0
		Patient cannot cross the legs without arm support on bed or table	☐ 1
		Patient crosses the legs but displaces the trunk more than 10 cm backwards or assists crossing with the hand	☐ 2
		Patient crosses the legs without trunk displacement or assistance	☐ 3
		Total static sitting balance	/7
	Dynamic sitting balance		
1	Starting position Patient is instructed to touch the bed or table with the hemiplegic elbow (by shortening the hemiplegic side and lengthening the unaffected side) and return to the starting position	Patient falls, needs support from an upper extremity or the elbow does not touch the bed or table	☐ 0
		Patient moves actively without help, elbow touches bed or table	☐ 1
		If score = 0, then items 2 and 3 score 0	
2	Repeat item 1	Patient demonstrates no or opposite shortening/lengthening	☐ 0
		Patient demonstrates appropriate shortening/lengthening	☐ 1
		If score = 0, then item 3 scores 0	
3	Repeat item 1	Patient compensates. Possible compensations are: (1) use of upper extremity, (2) contralateral hip abduction, (3) hip flexion (if elbow touches bed or table further then proximal half of femur), (4) knee flexion, (5) sliding of the feet	☐ 0
		Patient moves without compensation	☐ 1
4	Starting position Patient is instructed to touch the bed or table with the unaffected elbow (by shortening the unaffected side and lengthening the hemiplegic side) and return to the starting position	Patient falls, needs support from an upper extremity or the elbow does not touch the bed or table	☐ 0
		Patient moves actively without help, elbow touches bed or table	☐ 1
		If score = 0, then items 5 and 6 score 0	
5	Repeat item 4	Patient demonstrates no or opposite shortening/lengthening	☐ 0
		Patient demonstrates appropriate shortening/lengthening	☐ 1
		If score = 0, then item 6 scores 0	

Item			
6	Repeat item 4	Patient compensates. Possible compensations are: (1) use of upper extremity, (2) contralateral hip abduction, (3) hip flexion (if elbow touches bed or table further then proximal half of femur), (4) knee flexion, (5) sliding of the feet	☐ 0
		Patient moves without compensation	☐ 1
7	Starting position Patient is instructed to lift pelvis from bed or table at the hemiplegic side (by shortening the hemiplegic side and lengthening the unaffected side) and return to the starting position	Patient demonstrates no or opposite shortening/lengthening	☐ 0
		Patient demonstrates appropriate shortening/lengthening	☐ 1
		If score = 0, then item 8 scores 0	
8	Repeat item 7	Patient compensates. Possible compensations are: (1) use of upper extremity, (2) pushing off with the ipsilateral foot (heel loses contact with the floor)	☐ 0
		Patient moves without compensation	☐ 1
9	Starting position Patient is instructed to lift pelvis from bed or table at the unaffected side (by shortening the unaffected side and lengthening the hemiplegic side) and return to the starting position	Patient demonstrates no or opposite shortening/lengthening	☐ 0
		Patient demonstrates appropriate shortening/lengthening	☐ 1
		If score = 0, then item 10 scores 0	
10	Repeat item 9	Patient compensates. Possible compensations are: (1) use of upper extremities, (2) pushing off with the ipsilateral foot (heel loses contact with the floor)	☐ 0
		Patient moves without compensation	☐ 1
		Total dynamic sitting balance	/10
	Co-ordination		
1	Starting position Patient is instructed to rotate upper trunk 6 times (every shoulder should be moved forward 3 times), first side that moves must be hemiplegic side, head should be fixated in starting position	Hemiplegic side is not moved three times	☐ 0
		Rotation is asymmetrical	☐ 1
		Rotation is symmetrical	☐ 2
		If score = 0, then item 2 scores 0	
2	Repeat item 1 within 6 seconds	Rotation is asymmetrical	☐ 0
		Rotation is symmetrical	☐ 1
3	Starting position Patient is instructed to rotate lower trunk 6 times (every knee should be moved forward 3 times), first side that moves must be hemiplegic side, upper trunk should be fixated in starting position	Hemiplegic side is not moved three times	☐ 0
		Rotation is asymmetrical	☐ 1
		Rotation is symmetrical	☐ 2
		If score = 0, then item 4 scores 0	
4	Repeat item 3 within 6 seconds	Rotation is asymmetrical	☐ 0
		Rotation is symmetrical	☐ 1
		Total co-ordination	/6
		Total Trunk Impairment Scale	/23

REACHING PERFORMANCE SCALE

Appendix.
The Reaching Performance Scale

Close Target	Far Target
☐ 1. Trunk Displacement	
Close Target	**Far Target**
3. No or almost no forward trunk displacement	3. Appropriate forward trunk displacement related to the amount of elbow extension
2. Small displacement of the trunk (flexion, rotation, or flexion accompanied by rotation	2. Excessive trunk displacement related to a limitation of the active movement of the elbow or shoulder
1. More than half the movement is made by the trunk	1. Excessive trunk displacement: about half of the displacement of the hand toward the target is accomplished by the trunk, but the hand arrives at the target
0. Task is accomplished only by forward trunk displacement	0. Excessive trunk displacement: more than three fourths of the displacement of the hand to the target is accomplished by the trunk, and the hand does not arrive at the target
☐ 2. Movement Smoothness[a]	
Close Target	**Far Target**
3. The combination of movement of the arm and trunk is fluid and smooth	3. The combination of movement of the arm and trunk is fluid and smooth
2. More than one movement of the arm is made to perform the task, or the movement is segmented (not smooth)	2. More than one movement of the arm is made to perform the task, or the movement is segmented (not smooth)
1. Several small movements of the arm and trunk are made in a sequential manner	1. Several small movements of the arm and trunk are made in a sequential manner
0. Complete segmentation of arm and trunk movement	0. Complete segmentation of arm and trunk movement
☐ 3. Shoulder Movements	
Close Target	**Far Target**
3. Adequate shoulder flexion and horizontal adduction with scapular elevation to perform the task	3. Adequate shoulder flexion and horizontal adduction with scapular protraction and elevation to perform the task
2. Shoulder flexion and horizontal adduction occurs with excessive scapular elevation	2. Shoulder flexion and horizontal adduction occurs with excessive scapular protraction or elevation
1. Shoulder flexion occurs only in combination with excessive scapular elevation. Shoulder horizontal adduction is decreased.	1. Shoulder flexion is combined with scapular elevation. Shoulder horizontal adduction is decreased.
0. No or almost no shoulder flexion or horizontal adduction is possible (all the movement is made by the scapula)	0. No or almost no shoulder flexion or horizontal adduction is possible (all the movement is made by the scapula)
☐ 4. Elbow Movements	
Close Target	**Far Target**
3. Extending the hand to the target is principally attributed to elbow extension	3. Elbow extension is almost full
2. More than half of the reaching movement is attributed to elbow extension	2. More than half of the reaching movement is attributed to elbow extension
1. Less than half of the reaching movement is attributed to elbow extension	1. Less than half of the reaching movement is attributed to elbow extension
0. No elbow extension occurs	0. No elbow extension occurs
☐ 5. Prehension	
Close Target	**Far Target**
3. Adequate hand opening and closure to perform the task	3. Adequate hand opening and closure to perform the task
2. Opening or relaxing the hand is difficult	2. Opening or relaxing the hand is difficult
1. Use of compensatory grasping strategies (eg, winding fingers around a cone, downward grasping)	1. Use of compensatory grasping strategies (eg, winding fingers around a cone, downward grasping)
0. Prehension is not possible	0. Prehension is not possible
☐ 6. Global Score	
Close Target	**Far Target**
3. The task can be done easily, with or without mild tremor or dysmetria, following a smooth and direct trajectory	3. The task can be done easily, with or without mild tremor or dysmetria, following a smooth and direct trajectory
2. The task is done in the presence of tremor; dysmetria; small, jerky movements; arc-shaped trajectory; or segmentation. Prehension is possible but may be modified or difficult.	2. The task is done in the presence of tremor; dysmetria; small, jerky movements; arc-shaped trajectory; or segmentation. Prehension is possible but may be modified or difficult.
1. The task is done partially (more than 50%) or with modification (such as stabilization of the cone, sliding the cone on the table, modification of table height, shorter distance to the cone). Prehension may be absent.	1. The task is done partially (more than 50%) or with modification (such as stabilization of the cone, sliding the cone on the table, modification of table height, shorter distance to the cone). Prehension may be absent.
0. Less than half the task is accomplished despite modifications	0. Less than half the task is accomplished despite modifications

[a] Excludes assessment of tremor (rhythmic movements of constant frequency) or dysmetria (inaccuracies in aiming).

ABSTRACT

RELATION BETWEEN TRUNK IMPAIRMENT AND UPPER LIMB KINEMATICS OF REACHING NEAR AND FAR OBJECT UNDER ALTERED SENSATION IN POST STROKE PATIENTS

BACKGROUND AND PURPOSE OF THE STUDY: The development of trunk stability and control is considered to be a prerequisite to upper extremity (UE) function and use of the hand. It has been shown that proximal stability allows for independent use of the arms and hands in manipulative and purposeful activity. These studies have concluded that improvement in trunk control is related to significant changes in upper limb functions. Studies of motor recovery following stroke have shown that improvements in outcome measures such as speed, precision, and variability of arm movement may be accomplished by stroke patients in ways that may be maladaptive or compensatory. Moreover in literatures trunk control and upper limb functions were tested in stable conditions but in day today life patient has to experience many unstable conditions. Therefore it is important to find the relation between trunk impairment and kinematics of upper limb in unstable condition.

OBJECTIVE: To find the difference in trunk control on stable and unstable condition**,** To find the difference in upper limb kinematics in reaching on stable and unstable condition and also To find the relation between trunk impairment and upper limb kinematics during reaching on stable and unstable condition.

STUDY DESIGN: Cross-sectional study.
STUDY SETTING: Department of Neurology and Stroke Rehabilitation Centre, PSG IMS&R hospitals, Coimbatore.
PARTICIPANTS: 30 hemiparetic patients
INTERVENTION: Not applicable.
STUDY PROECDURE: The informed consent will be obtained from the patient. Patient will be assessed for eligibility based on the inclusion and exclusion criteria. Eligible patients will be assessed for trunk impairment and reaching for near and far object on a stable surface. Then the same test will be repeated by making the patient to sit on a foam pad which provides altered sensation and unstable condition. Data's will be collected and analyzed using appropriate statistical tools

OUTCOME MEASURES: 1) Reaching performance scale **2)** Trunk impairment scale.

RESULTS: Using paired t test,The mean of trunk impairment in stable and unstable condition was found to be 17.37 and 16.63 respectively, paired 't' test value was 3.832,which was less than $p<0.05$. The mean of RPS reaching near object in stable and unstable condition was found to be 13.07 And 12.17 respectively, paired 't' test value was 5.341,which was less than $p<0.05$.The mean of RPS reaching far object in stable and unstable condition was found to be 12.27 and 10.80 respectively, paired 't' test value was 6.416,which was less than $p<0.05$. A Pearson product-moment correlation analysis shows that there is a strong, positive correlation between trunk impairment score and, upper limb kinematics, which includes reaching near object in stable ($r=0.743$, $p<0.05$), reaching far object in stable ($r=0.789$, $p<0.05$), reaching near object in unstable ($r=0.765$, $p<0.05$) and reaching far object in stable ($r=0.769$, $p<0.05$) with trunk impairment variable, which is statistically significant.

CONCLUSION: It is concluded that"**There is significant difference in trunk control and upper limb kinematics in reaching on stable and unstable condition and there is significant correlation between trunk impairment and upper limb kinematics during reaching on stable and unstable conditionin stroke subjects**".

Keywords: Trunk Impairment, Kinematics, Altered Sensation, Post Stroke.